The History of a Mind.

Pasteur: The History of a Mind. By Prof. Emile Duclaux. Translated by Erwin F. Smith and Florence Hedges. Pp. xxxii + 363. (Philadelphia and London: W. B. Saunders Company, 1920.) Price 21*s*. net.

PASTEUR has been fortunate in his biographers. There is the well-known life by René Vallery-Radot, which describes for us the man himself, his noble, impulsive character, his thirst for knowledge and zeal for humanity, and gives a general account of his researches and discoveries; an essay by Sir George Newman, which appeared some twenty years ago and deserves republication, expresses in eloquent terms an appreciation of Pasteur's life-work from the English point of view; while, for the purpose of scrutiny of the details of the discoveries themselves, we possess studies by two of the master's disciples, Duclaux and Roux. The volume now under review is a translation by two American pathologists of Emile Duclaux's "Histoire d'un Esprit." In French it is the volume which every serious student of Pasteur's work has read, and it is a little surprising to find, not only that twenty-four years have apparently elapsed before the appearance of an English translation, but also that the original work appears to be almost unknown outside France, according to the senior translator.

The introduction to the book takes mainly the form of a brief memoir of the author. As Boswell derives his fame from Dr. Johnson, and Lockhart is known as the biographer of Scott, so Duclaux will live chiefly in the shadow of Pasteur and by this book. As a chemist, he was first closely associated with Pasteur in 1862 at the École Normale; separated from him for a short time on becoming professor of chemistry at Tours, he was soon transferred to Clermont-Ferrand, where a portion of his time could be given to Pasteur's work; subsequently he went to Lyons as professor of physics for five years, and in 1878 he came to Paris as professor of meteorology in the Agronomic Institute. In 1888, when the Pasteur Institute was founded, Duclaux joined the staff assembled under the command of Pasteur, numbering such illustrious names as Chamberland, Roux, Nocard, Grancher, Metchnikoff, and Yersen among his colleagues. Duclaux's function was the intelligence department, the dissemination of discoveries to the world—not the actual research work. He founded *Les Annales de l'Institut Pasteur*, and in so doing created the channel through which the wealth of the discoveries made by Pasteur and his co-workers poured to the open sea of scientific knowledge. Duclaux was an organiser. He wrote well, with all the vivacity and picturesque style of which a master of the French language is capable; there is not a dull page in his scientific treatises. He found his *métier* as an editor and an interpreter of the labours of others. An ardent toiler, who early adopted Pasteur's motto, "*il faut travailler toujours*," Duclaux himself did little original work. His books, "Ferments et Maladies" (1882) and "Le Microbe et la Maladie" (1885) were records of Pasteur's labours; he collated and co-ordinated the scattered facts on enzymes, classed them into groups according to their reactions, and proposed a scheme of terminology for them. In a word, he was one of the earliest administrators in science. On the death of Pasteur, in 1895, he succeeded him as director of the Institute, and died himself in 1904.

In the book before us, Duclaux traces in detail the steps by which Pasteur was led to make his famous discoveries. "*Que peut bien être l'histoire d'un esprit?*" is the first sentence of the original work, and then the author proceeds to show how, in the hands of Duclaux, the task is possible. Guided by him, we follow Pasteur through the thicket of truth and error. We observe how, amid the storm of criticism and controversy, Pasteur advanced unshaken, and if ever he missed his way for a moment, as in the earlier days of the conflict on spontaneous generation, how speedily and surely he retraced his steps. Duclaux tells us the fascinating story of the first work on crystallography, when the foundations of stereochemistry were well and truly laid. As a chemist, Duclaux lingers over this early work; we can readily understand how great a pure chemist was lost in Pasteur when he chose to become the first bacteriologist. Yet, as Duclaux reveals to us, all Pasteur's life-work pursued an orderly sequence: the study of crystals led to the researches on ferments. "If one of the salts of racemic acid, paratartrate or acetate of ammonia, for instance, is placed in the ordinary conditions of fermentation, the dextro-tartaric acid remains in the liquor, the reason being that the ferment of that fermentation feeds more easily on the right than on the left molecules." Pasteur found then that molecular dissymmetry appeared as a modifying agent on chemical affinities in a physiological phenomenon, and it was a mere step for his mighty intellect to proceed to solve the problems of lactic and alcoholic fermentations, of spontaneous generations, and of the diseases of wines and silkworms. Short, too, was the step again for Pasteur from these studies towards the etiology of microbial diseases, the wonderful work

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on anthrax and on chicken cholera, the problems of immunity, virulence, and attenuation, and the crowning work on rabies.

All this we read with the avidity of a child for a twice-told tale, and the pen of Duclaux transports us back to the days when these discoveries were revolutionising the realms of medicine and surgery. Sir Rickman Godlee's "Life of Lord Lister" has reminded us afresh of the influence that Pasteur exercised on that great surgeon's work, a debt which Lister acknowledged from the inception of his own researches. Duclaux deals more briefly with the later discoveries of Pasteur, possibly because his own studies had lain more in the direction of the researches on crystallography and fermentations; this, however, is no blemish upon the book, which must always remain a classic in the history of science.

The translation has been faithfully done; at times too faithfully. Thus, on p. 7, "The general law, just now stated, that a science progresses above all by changing its point of view, explains the aid which it always derives from kindred sciences," is too literal a rendering of "La loi générale énoncée tout à l'heure, qu'une science progresse surtout en changeant ses points de vue, explique le secours qu'elle tire toujours des emprunts faits aux sciences ses voisines."

The book is well printed, and illustrated by several portraits of Pasteur at different ages and by two portraits of Duclaux. A good index has been prepared by the translators, who are also responsible for an innovation in a scientific work in respect of a "Who's Who" of persons mentioned in the book. Lister's knighthood is given, but not his peerage.

Duclaux's work thus presented should find new readers both in Great Britain and America.

A. S. M.

Applied Plant Ecology.

Plant Indicators: The Relation of Plant Communities to Process and Practice. By Frederic E. Clements. (Publication No. 290.) Pp. xvi+388+92 plates. (Washington: The Carnegie Institution of Washington, 1920.) Price 7 dollars.

DR. CLEMENTS'S enthusiastic and prolific researches in pure ecology are well known to botanists. In his latest publication he endeavours to apply his principles and methods to the practical problems of agriculture, stock-raising, and forestry, with special reference to the Western United States. According to his view, every plant is an indicator of "conditions, processes, or uses," because it is the product of the conditions under which it grows. The individual, the species, or the community may serve as an indicator, and the choice of the unit to be employed in a given case will depend partly upon the practical end in view, and partly upon the ecological data available. To give a concrete instance: the *species Mertensia sibirica* indicates the *condition* "deep shade" in the montane forest of Colorado. In using plant-communities as indicators Dr. Clements relies mainly upon the dominant species, so that in practice there appears to be no sharp distinction between specific and community indicators. His general classification of types of grazing-land, however, is based upon plant-communities, inasmuch as a uniform community of grass, weed, or browse is held to indicate suitability for cattle, sheep, or goats respectively, while a prairie or a grass-scrub mictium [*i.e.* a mixed community containing dominants both from grass- and from scrub-associations] [1] or savannah denotes the advisability of mixed grazing by two or three kinds of animals. As an example of "individual" indicator-criteria, it is stated that ten "water-ecads" [*i.e.* habitat-forms corresponding to ten different degrees of water-supply] of *Ranunculus sceleratus* have been produced experimentally; plate 11 further shows photographs of [natural] shade, alpine, and "normal" ecads of *Campanula rotundifolia, Gentiana amarella,* and *Androsace septentrionalis.*

The nature of plant-indicators, briefly explained above, forms the principal topic of the first section (chaps. i.–iii.), which also deals with the determination and application of indicators, and includes a short historical *résumé* of the indicator concept. Chap. iv. gives a summary review of the climax [*i.e.* climatic] formations of western North America, and, judged by the account of Chapparal-formations—which the reviewer is best able to appreciate from personal knowledge of analogous Mediterranean formations—is adequate on the descriptive side; some useful information regarding rainfall and other environmental factors is included, and the dominant species are recorded for each formation. Altogether this chapter, already outlined in a former paper [F. E. Clements, "Plant Succession," Carnegie Institution, No. 242, 1916], is a very useful addition to the literature of plant geography.

The most interesting portion of the book is the last—roughly one-third of the whole—in which Dr. Clements discusses in detail the practical employment of indicators in the interests of farmers, stock-raisers, and foresters. A striking feature

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[1] Words in square brackets are the reviewer's.

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